



EBAF Update



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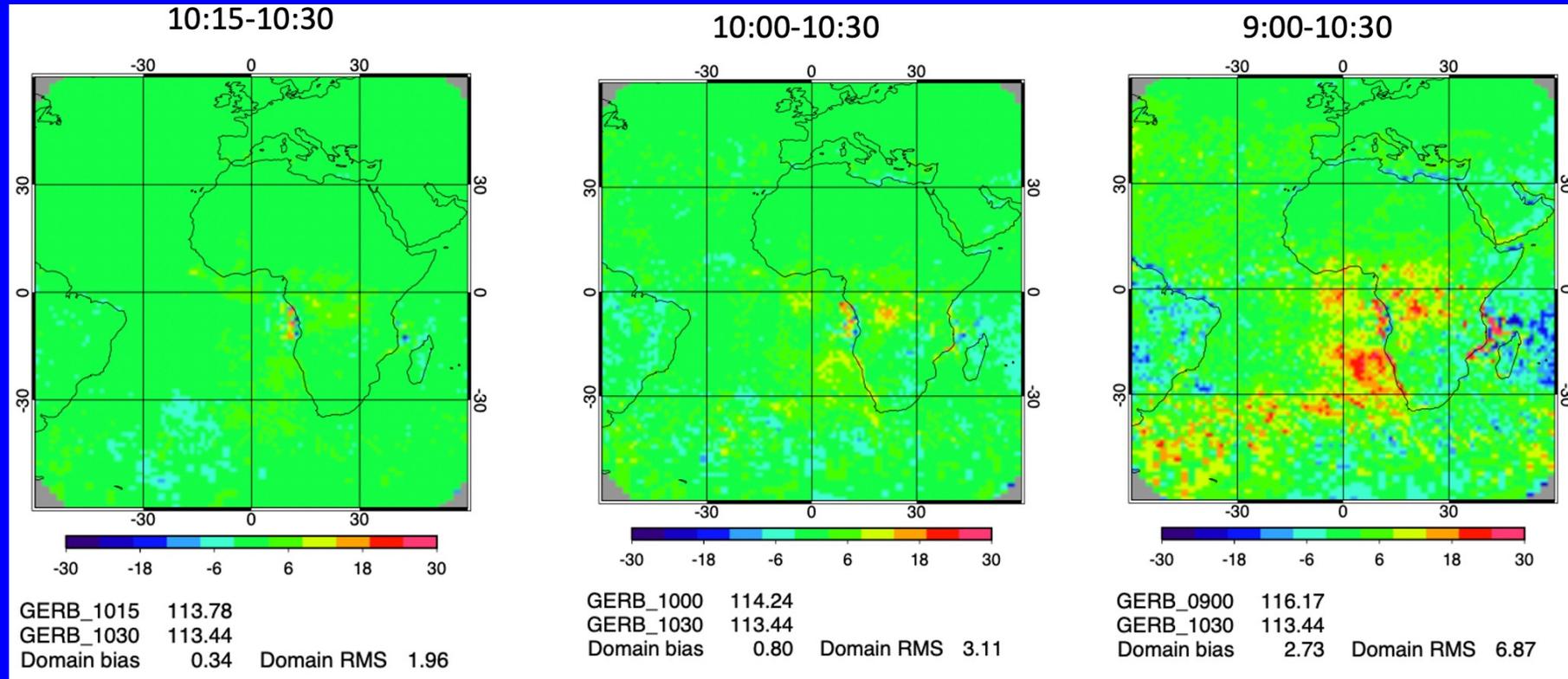
CERES Science Team Meeting, October 12-14, 2021
Virtual Meeting

Introduction

- Current version of EBAF (Ed4.1) uses Terra-Only for 03/2000-06/2002 and Terra+Aqua for 07/2002 onwards.
- An update to EBAF prior to Edition 5 is necessary in order to account for:
 - 1) Changes in Terra and Aqua MLTs.
 - 2) Artifacts and discontinuities in GEO cloud retrievals, which impact EBAF surface fluxes.
 - 3) Discontinuities with time in GEOS 5.4.1 meteorological inputs, which impact EBAF surface fluxes.
- New version will be called EBAF Ed4.2.
- **Timeline:** Reprocessing of input data needed for EBAF Ed4.2 will complete in June 2022. Anticipate public release of full (TOA & SFC) EBAF Ed4.2 during fall of 2022.

Impact of a Change in MLT on SW Reflected Solar Radiation

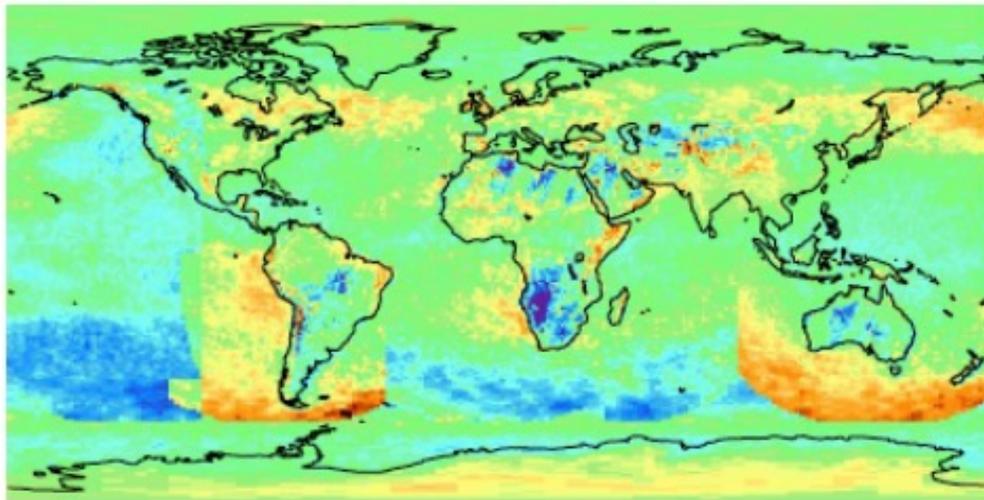
- Compare GERB SW TOA flux at 10:15 am, 10:00 am and 9:00 am vs 10:30 am
- Normalize each observation to a common 10:30 am solar geometry



- To avoid discontinuity in CERES record, MLT must remain within 15 min of 10:30 am for Terra and 1:35 pm for Aqua.
- EBAF will be reprocessed to ensure an MLT < 15 min by transitioning from Terra+Aqua to NOAA-20.

Downward LW Flux at Surface: Sensitivity to GEO Cloud Retrieval Artifacts (Computed DLW MODIS-Only minus Computed DLW MODIS+GEO)

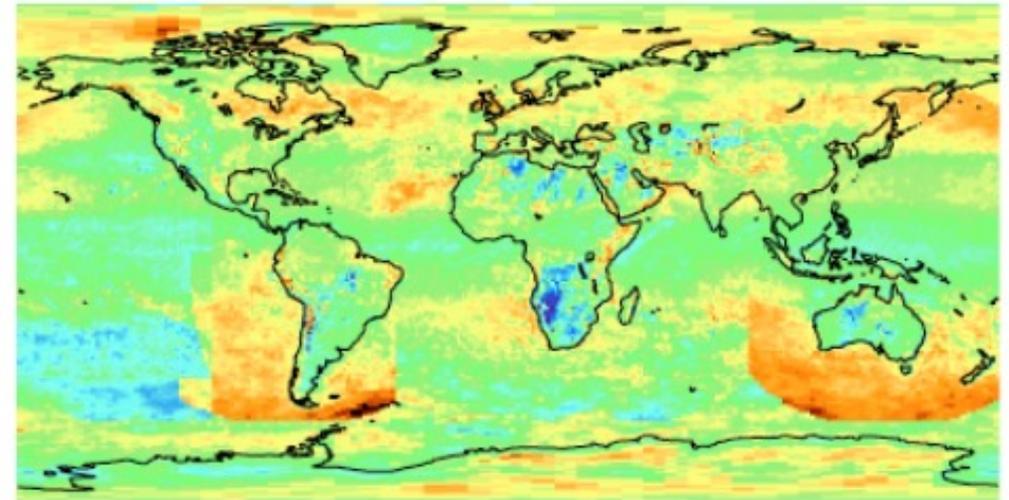
Ter+Aqu_MODIS minus SYN1deg_Ter+Aqu+GEO
(July 2019)



-14.5 -8.7 -2.9 2.9 8.7 14.5

Difference (Wm^{-2})

Terra+Aqua_MODIS minus EBAF Ed4.1
(July 2019)



-20 -12 -4 4 12 20

Difference (Wm^{-2})

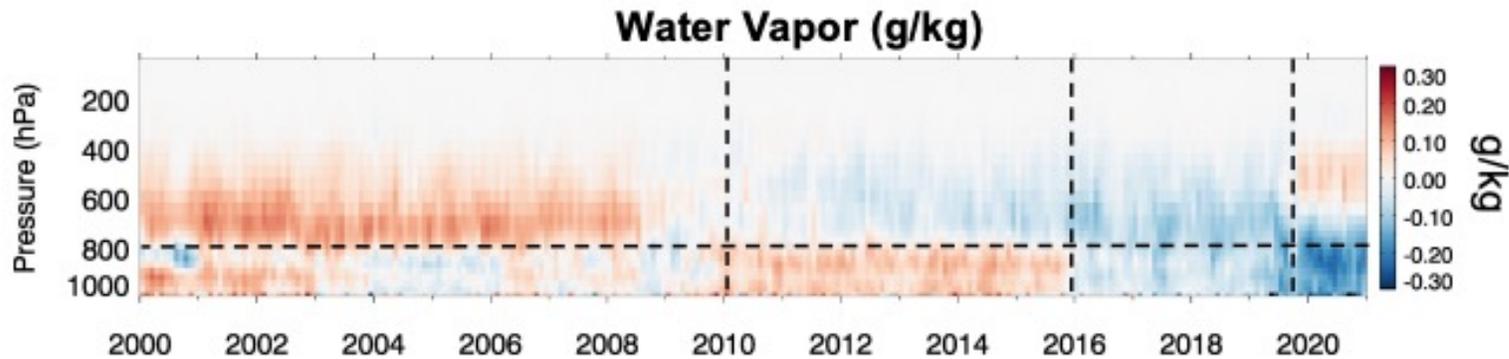
- The largest effects of GEO artifacts on surface downward longwave flux come from nighttime cloud optical thickness (and depend on GEO).

Discontinuities in GEOS 5.4.1 Water Vapor Profiles

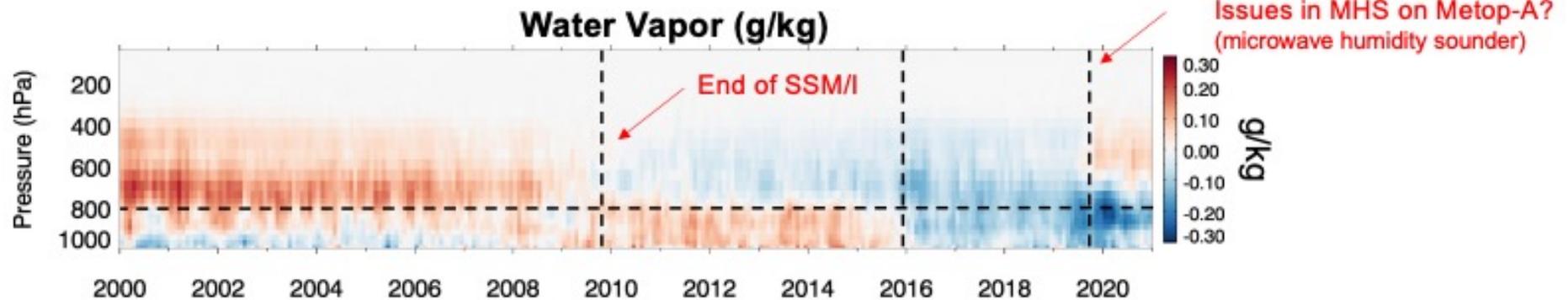
60S-60N Land+Ocean

Area weighted; climatology is obtained using 2003-2020

[G-5.4.1 WV Anomalies] – [MERRA-2 WV Anomalies]



[G-5.4.1 WV Anomalies] – [ERA-5 WV Anomalies]



- The differences between G541 and ERA5 are similar to those between G541 and MERRA-2.
- This implies that the differences are mainly driven by G541 problems.
- The discontinuities in G541 might be related to input observing data changes.

Planned Changes in EBAF Processing

1) Transition to NOAA-20:



Note: Climatology of Terra-Only and NOAA20-Only will be anchored to Terra+Aqua climatology using overlapping periods.

- 2) **EBAF-Surface fluxes will be processed with MODIS/VIIRS imager cloud retrievals (no GEO).**
- 3) **EBAF-Surface fluxes will be re-calculated using MERRA-2 meteorological inputs.**
 - MODIS/VIIRS imager cloud properties will not be reprocessed (based upon GEOS 5.4.1)

TOA Flux Changes

- 1) Diurnal correction bug fix near international dateline
- 2) Climatological adjustment of TOA fluxes during Terra-only time period using Terra+Aqua climatology
- 3) Compiler differences (P6 vs x86)
- 4) Sampling: Recovery of some of the missing GEO data in Ed4.1.

CERES EBAF Ed4.0 Empirical Diurnal Corrections

- Use daily SYN1deg & SSF1deg files for 07/2002 – 06/2015 to compute climatological monthly mean ratios of SYN1deg-to-SSF1deg sorted by:

1) Month (1-12)

2) Surface Type: Open ocean (No snow), Desert, Other.

3) Diurnal Asymmetry Ratio (DAR):

$$\text{DAR} = \{[F^{\text{SW}}(\text{morn}) - F^{\text{SW}}(\text{aft})] / 12\} / F^{\text{SW}}(24\text{h})$$

- Develop diurnal corrections for Terra SSF1deg, Aqua SSF1deg, and Terra-Aqua SSF1deg.

Application:

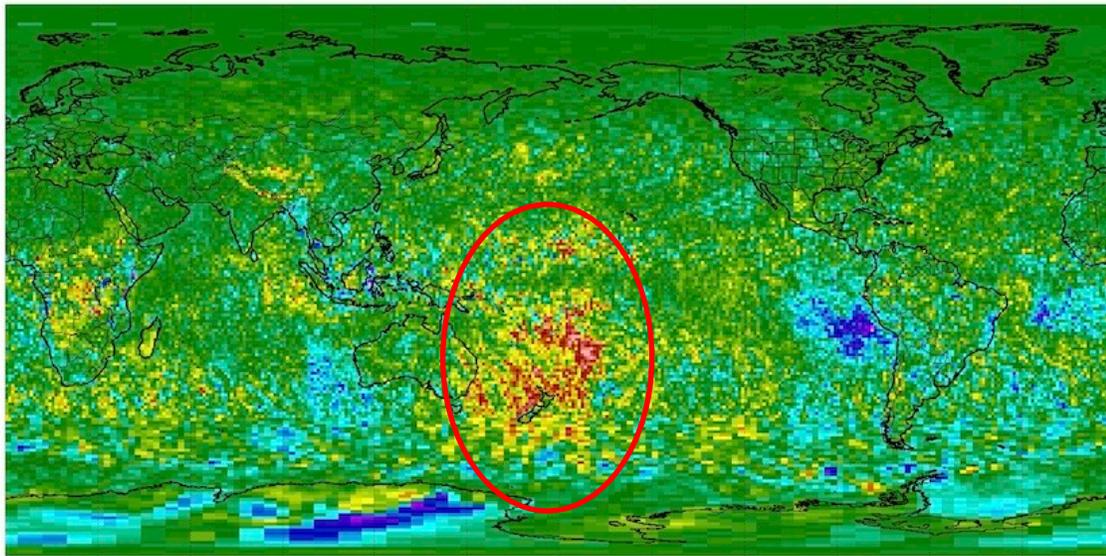
- Convert daily mean SSF1deg fluxes to diurnally corrected values (“SYN1deg-Like”).
- Average diurnally corrected SSF1deg fluxes to monthly means.

Diurnal Asymmetry Ratio: Before and After Correction (October 2016)

BEFORE

EBAF(Terra&Aqua) – EBAF(Aqua) Ed4.1

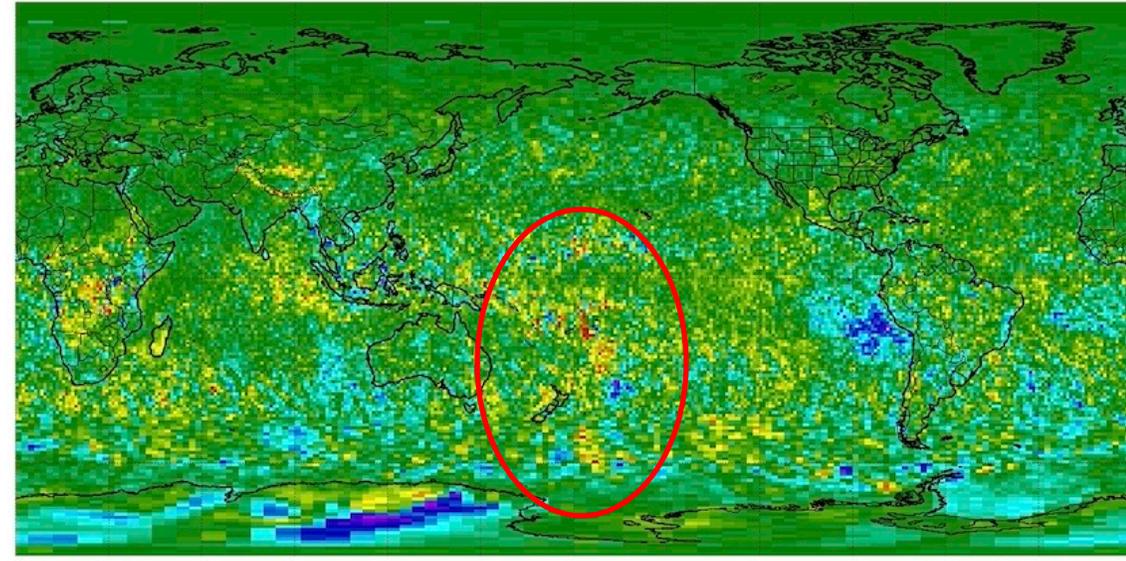
October - 2016



AFTER

EBAF(Terra&Aqua) – EBAF(Aqua) DAR fix

October - 2016 ** Anomaly Field **



- Problem was related to the way DAR was calculated (GMT vs local time)
- Also found there was a day of hourly GEO data missing over Him-8 domain (90-180E)

Terra-Only & NOAA20-Only Climatological Adjustment

- **Terra-Only:** Use 5-year overlap with Terra+Aqua (07/2002-06/2007) to anchor Terra-Only period (03/2000-06/2002) to Terra+Aqua.
- **NOAA20-Only:** Use 4-year overlap with Terra+Aqua (07/2018-06/2022) to anchor NOAA20-Only period (07/2022-onwards) to Terra+Aqua.

$$\begin{aligned}
 F'_T(\lambda, \phi; yr, mn) &= F_T(\lambda, \phi; yr, mn) + \{\bar{F}_{TA}^O(\lambda, \phi; mn) - \bar{F}_T^O(\lambda, \phi; mn)\} \\
 &= F_T(\lambda, \phi; yr, mn) + \bar{\Delta}^O(\lambda, \phi; mn)
 \end{aligned}$$

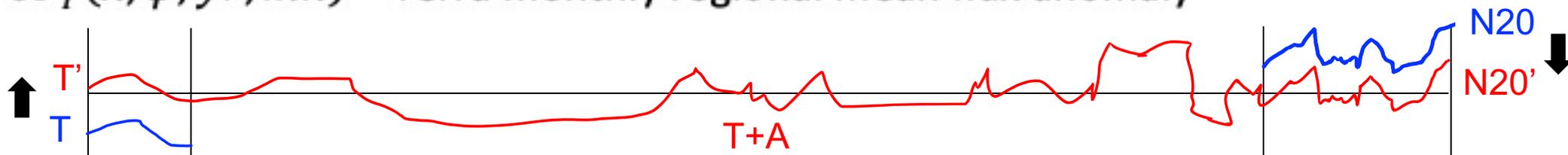
By definition: $\delta F'_T(\lambda, \phi; yr, mn) = \delta F_T(\lambda, \phi; yr, mn)$

$F_T(\lambda, \phi; yr, mn)$ = Terra monthly regional mean flux

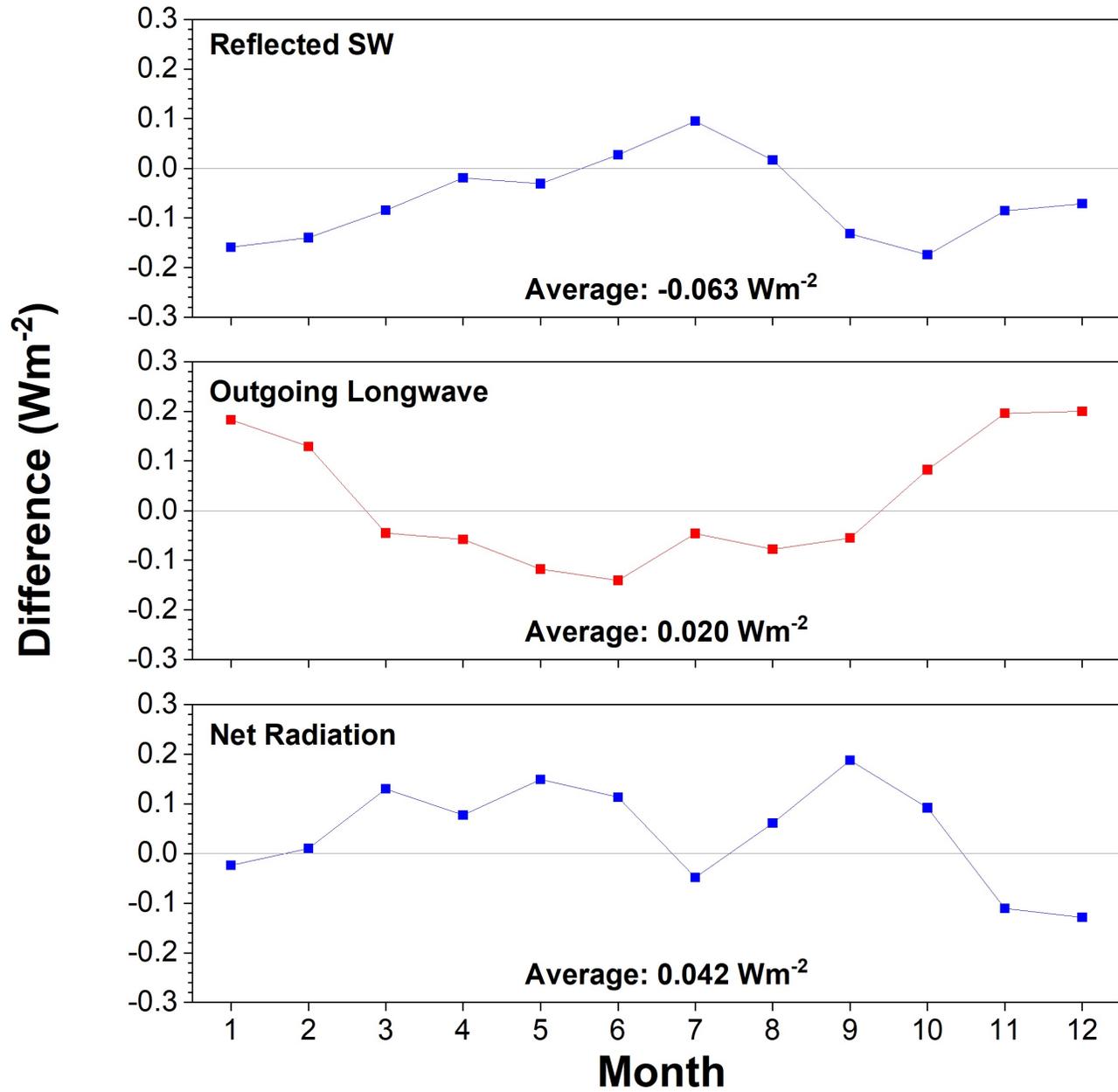
$\bar{F}_T^O(\lambda, \phi; mn)$ = Terra climatological monthly regional mean flux for overlap period

$\bar{F}_{TA}^O(\lambda, \phi; mn)$ = Terra+Aqua climatological monthly regional mean flux for overlap period

$\delta F_T(\lambda, \phi; yr, mn)$ = Terra monthly regional mean flux anomaly



Change in Terra-Only TOA Fluxes Due to Climatological Adjustment $\bar{\Delta}^0$



Current Status of EBAF Ed4.2 TOA Fluxes

- Reprocessing of Terra for Terra-only period (March 2000 – June 2002) is complete
- Reprocessing of Terra for 5-year overlap with Terra+Aqua (July 2002 – June 2007) is complete
- Reprocessing of 20 years of Terra+Aqua (July 2002 – June 2022) is in progress
- Reprocessing of N20 for 4-year overlap with Terra+Aqua (July 2018 – June 2022) will start next month

Timeline:

- The last month of EBAF Ed4.1 will be June 2022, to be released in September
- EBAF Ed4.2 forward processing using only NOAA-20 will start with July 2022, likely in October.
- EBAF TOA-only will likely be available before full EBAF product (TOA & SFC)